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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Sailing Vessel

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(57) 9 Claims

2119417

ABSTRACT OF THE DISCLOSURE

A multi-hull sailing vessel has a centre hull provided with a mast and sails and respective pontoons carried by a transverse pontoon suspension beam that is pivoted to the centre hull. Relief breaking means is provided and normally prevents pivotal movement of the centre hull with respect to the beam, but can release to allow the centre hull to heel over and spill wind from the sails in abnormal weather conditions. The vessel is also provided with keel that can be raised and lowered under power according to sailing conditions, and locked in place.

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Title: SAILING VESSEL

FIELD OF THE INVENTION

This invention relates generally to sailing vessels and is concerned more particularly (though not exclusively) with a multi-hull sailing vessel such as a trimaran. Typically, a trimaran has a main centre hull with two secondary hulls or "pontoons", one on each side, connected to the main hull by outriggers.

BACKGROUND OF THE INVENTION

Traditional multi-hull vessels are very fast on "non-upwind" points of sail. However, they have one very serious safety flaw. If a multi-hull should capsize, it will stay capsized; it has no mechanism for self-righting. Multi-hulls are known to capsize as a result of strong or gusty winds forcing one of the outriggers underwater, thereby causing the vessel to "trip" on the submerged pontoon and capsize. Further, a conventional multi-hull has very limited "up-wind" capabilities due to its configuration, drag and lack of an efficient, high-aspect ratio keel.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a multi-hull vessel which is designed to address the shortcomings of the prior art.

In one aspect, the invention provides a sailing vessel having a centre hull structure which includes at least one mast carrying a sail, a pair of pontoons disposed on respectively opposite sides of the centre hull structure and means coupling the pontoons to the centre hull structure so as to allow the hull structure to pivot laterally with respect to the pontoons about a longitudinal axis generally parallel to the pontoons. The vessel also includes means normally resisting such pivotal movement but adapted to release and permit the centre hull structure to heel over when exposed to exceptional wind forces in use, while allowing the pontoons to remain

afloat. In other words, a vessel of this design will avoid the problem of a "down wind" pontoon being forced under water, resulting in the vessel capsizing. As such, the vessel should be capsize-proof or at least have much less tendency to capsize than a conventional multi-hull.

The two pontoons may be structurally coupled together by at least one beam that extends transversely with respect to the main hull structure and is pivotally coupled thereto about a pivot disposed axis longitudinally of the hull structure. Pivotal movement of the hull structure may be resisted by so-called "relief breaking means" which normally holds the beam in a substantially fixed relationship with respect to the pivot point but which is adapted to release when subjected to load above a predetermined threshold, so as to allow the hull structure to heel over and spill the wind out of the sail or sails without allowing the downwind pontoon to become submerged.

Preferably, means is also provided for righting the hull structure with respect to the pontoons when the abnormal wind conditions have abated. These righting means may be separate from the relief breaking means, or the two "means" may be integrated with one another. A preferred embodiment of integrated relief breaking means and righting means is described below by way of example, but a person skilled in the art will appreciate that these functions can be provided in other ways using equipment that is conventionally available.

The invention also provides a novel "lift-keel" for a sailboat that may be used in combination with the multi-hull vessel design provided by the invention, or in a conventional single or multi-hull sailboat.

This aspect of the invention provides for a keel that can be moved between raised and lowered positions to provide for different characteristics according to sailing conditions. In both of its positions, the keel will be rigidly locked to the hull.

A conventional "lift-keel" design utilizes either a removable "dagger-board" or a pivoted centre-board. Both of these concepts in their current configuration as found on conventional vessels are problematic in that they vibrate or are not rigidly fixed to the main hull. The inventive "lift-keel" design will incorporate a minimum of two settings, up or down (additional settings may also be provided). The keel lifting mechanism, may incorporate a hydraulic or worm-gear mechanical lifting system mounted in or on the hull (preferably two linked units -- one on each side of the keel) and connected to a structural beam which will be fastened perpendicular to the keel. This will ensure that the keel is lifted or lowered straight.

To ensure that the keel is structurally locked into place (within the main hull), complimentary male and female locking formations may be provided for each keel position so that the keel can be locked into place and will form part of the vessel's structure.

It is believed that a vessel which incorporates a "lift-keel" configuration will have exceptional "upwind" performance due to its large draft. The keel will be hydrostatically designed to maximize "lift" with a large "wing" shape. "Downwind" performance will be enhanced by the ability of the keel to be lifted, thereby reducing drag.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which illustrate particular preferred embodiments of the invention by way of example, and in which:

Fig. 1a is a schematic front elevational view of a multi-hull sailing vessel in accordance with the invention, shown in a normal sailing configuration;

Fig. 1b is a view similar to Fig. 1a showing the mast of the vessel as having heeled over as a result of exceptional wind forces;

Fig. 2 is a plan view corresponding to Figs. 1a and 1b; and,

Figs. 3a and 3b are schematic transverse sectional views through the hull of a sailing vessel provided with a "lift-keel" in accordance with the invention, the keel being shown respectively in raised and lowered positions in the two views.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to Fig. 1a, a multi-hull sailing vessel in accordance with the invention is shown to include a centre hull structure which is generally denoted 20, and which includes a hull 22 having a keel 24 and a mast 26 carrying sails 28.

A pair of pontoons, each denoted 30, are provided on respectively opposite sides of the centre hull structure 20. The pontoons are coupled to the centre hull structure 20 so as to allow the structure to pivot laterally with respect to the pontoons about a longitudinal axis A generally parallel to the pontoons. As best seen in Fig. 2, the axis is co-incident with a vertical median plane through hull 22. Fig. 1a shows the vessel in a normal sailing configuration, while Fig. 1b, shows the hull structure as having heeled over with respect to the pontoons.

Referring to Fig. 2, the pontoons are carried by fore and aft suspension beams 32 and 34 that extend transversely with respect to the main hull 22. It can be seen from Figs. 1a and 1b, the suspension beams have an arch configuration and are coupled to the main hull 22 at respective overhead pivot points provided by short pivot shafts denoted 36 and 38 (see Fig. 2). The pivot shafts are carried by respective, cross braced pivot supports generally indicated at 40 and 42 respectively at the top of the main hull 22.

In accordance with the invention, the vessel is provided with means which normally resists pivotal movement of the main hull structure 20 with respect to the

pontoon suspension beams 32 and 34, but which can release and allow the hull structure to heel over when the sails are exposed to extreme wind forces. As noted previously, the wind can then spill out of the sails while the pontoons remain afloat, preventing the vessel from capsizing.

These "means" may be provided by a so-called "relief breaking system" which will essentially act as a brake on the two pivot shafts 36 and 38. The relief braking system will be activated by a load sensing device which will measure the load on the "downwind" pontoon. Should the load be greater than a pre-determined threshold (preferably, the load just before the pontoon would submerge under water) the system will release, allowing the centre hull to keel over (thereby reducing the pressure on the downwind pontoon). Once the wind pressure has decreased the system may mechanically (e.g. by gears, springs or hydraulic means) raise the centre hull to its centre or upright position.

To further assist in stability, the pontoons 30 may also act as ballast tanks with a pumping system (not shown) which will enable liquid ballast to be moved from one pontoon to the other in as short a time period as possible. This will enable the ballast to be placed where it is needed. Further, for light wind conditions, the ballast can be emptied entirely thereby reducing weight and drag.

It will be apparent to a person skilled in the art that a "relief braking system" in accordance with the invention can be implemented in a variety of different ways, one of which is illustrated in Figs. 1a and 1b. In this embodiment, a pair of hydraulic rams are provided at opposite sides of the main hull 22, in association with each of the pontoon suspension beams 32 and 34. The rams associated with beam 34 are shown in Figs. 1a and 1b and are denoted respectively 44 and 46. Each ram extends between the main hull 22 and the portion of the suspension beam at the that side of the hull. Load cells denoted 48

are provided in the respective pontoons and provide information to a microprocessor 50 within the hull. Microprocessor 50 in turn controls hydraulic circuitry (not shown) for providing hydraulic fluid to the respective rams 44 and 46 (and to corresponding rams associated with pontoon suspension beam 32).

The relief braking system overall (including the hydraulic rams and associated circuitry and controls, the load cells in the pontoons and the microprocessor) will be calibrated so that, when either of the load cells detects that a pontoon is being loaded above a certain threshold, the hydraulic pressure to the rams 44 and 46 (and the corresponding rams associated with beam 32) will be released, freeing the centre hull structure 20 to pivot about axis A with respect to the suspension beams. Fig. 1b shows the vessel in this condition. The wind (coming from the right) can spill out of the sails and the pontoons will remain afloat; in particular, the "downwind" pontoon (on the left in Fig. 1b) will not be forced below the water.

A relief braking system such as that described, which includes hydraulic rams, has the advantage that it can also be designed to restore the vessel to its normal configuration, either automatically or under manual control. For example, as seen in Fig. 1b, hydraulic ram 44 is extended while ram 46 is compressed. By extending ram 46 and retracting ram 44 under hydraulic power, the main hull structure 20 can be righted and effectively "locked" in the normal sailing position shown in Fig. 1a.

It should again be emphasized that the particular relief braking system shown is one embodiment only and that a similar result may be accomplished in other ways. For example, separate means could be provided for releasing the pivot and restoring the normal sailing configuration of the vessel. In a low-cost version of the vessel, restoration might be left to manual effort.

Figs. 3a and 3b illustrate the "lift keel"

feature of the invention. It is to be understood that this feature may be employed in combination with or separately from the embodiment shown in Figs. 1a, 1b and 2, and in a single or multi-hull vessel.

In Figs. 3a and 3b, the hull itself is generally denoted 52 and the keel 54. A structural beam 56 is rigidly connected to the keel 54 and extends transversely with respect to the plane of the keel (and the longitudinal centreline of the hull). The keel may be provided with a single beam 56, for example, at the centre of the keel, or beams may be provided at both ends of the keel. In either event, the or each beam 56 (and hence the keel 54) is guided for up and down movement within the hull, on a pair of rods 58 and 60 that are rigidly mounted within the hull. Thus, the keel can be moved between the raised position in which it is shown in Fig. 3a, in which only a relatively small part of the overall depth of the keel is exposed below the hull, and the lowered position shown in Fig. 3b, in which substantially the entire depth of the keel is exposed. Typically, the raised position of Fig. 3a would be used to provide enhanced "downwind" performance, while the lowered position of Fig. 3b would be used for "upwind" sailing.

The keel can be locked to the hull in either of its two positions by co-operating male and female locking formations on beam 56 and the hull. For example, as seen in Fig. 2, upwardly projecting locking formations 62 are shown received within complimentary recesses below the deck of the hull. Those recesses are best seen in Fig. 3b, where they are denoted 64.

Similarly, in the lowered keel position of Fig. 3b, downwardly extending projections 66 on beam 56 are shown received within recesses 68 (see Fig. 3a) in the bottom of the hull.

In principle, particularly in small vessels, the keel could be raised and lowered manually and held in its raised or lowered position, for example, by turn buttons

or other mechanical locking devices. Preferably, however, powered raising and lowering means are used.

For example, hydraulic or worm-gear mechanical lifting systems may be used. One such system is schematically illustrated in Fig. 3a. In this embodiment, each of the guide rods 58, 60 is a threaded rod and is received in a complimentarily threaded opening in beam 56. The two rods extend upwardly through the deck of the vessel and are provided with respective gear wheels 70, 72 which mesh with corresponding worm wheels 74, 76, each driven by an electric motor 78, 80. The motors will of course be appropriately synchronized to turn the rods 58 and 60 in unison at the same speed. It is to be understood that the illustration given is schematic and by way of example only. In practice, the worm drive mechanisms would normally be accommodated within the hull of the vessel.

It should also be noted more generally that, while the preceding description refers to particular preferred embodiments of the invention only, many modifications are possible within the broad scope of the invention. Some of those modifications have been indicated previously and others will be apparent to a person skilled in the art.

It should be noted, for example, that while specific reference has been made to a vessel having three hulls (a main centre hull and two pontoons), there is no limitation to this particular configuration. For example, the centre hull structure could itself comprise two separate hulls. It should also be noted that, while the drawings show what is probably a preferred configuration in terms of pontoons carried by one or more individual suspension beams having a central pivot, each pontoon could be carried by a separate beam or beams pivoted individually to the centre hull structure. Each pivot would then have to be provided with a relief braking system or the like.

I CLAIM:

1. A sailing vessel comprising a centre hull structure which includes at least one mast carrying a sail;

a pair of pontoons disposed on respectively opposite sides of the centre hull structure;

means coupling the pontoons to the centre hull structure so as to allow that structure to pivot laterally with respect to the pontoons about a longitudinal axis generally parallel to the pontoons; and,

means normally resisting such pivotal movement but adapted to release and allow the centre hull structure to heel over when exposed to exceptional wind forces, while allowing the pontoons to remain afloat.

2. A vessel as claimed in claim 1, wherein the pontoons are carried by at least one pontoon suspension beam that extends transversely of the centre hull structure and is pivotally coupled to that structure in a vertical median plane thereof.

3. A vessel as claimed in claim 2, wherein the centre hull structure includes a single centre hull, and wherein the pontoon suspension beam extends over said hull and is pivotally coupled thereto in an overhead location.

4. A vessel as claimed in claim 3, wherein said means normally resisting pivotal movement of the centre hull structure with respect to the pontoons comprises a pair of hydraulic rams disposed at respectively opposite sides of the hull and extending between the hull and the pontoon suspension beam, and means for controlling said rams in response to wind forces imposed on the vessel, so that the rams normally resist pivotal movement of the hull structure with respect to the pontoons but release at a predetermined threshold pressure to allow the centre

structure to heel over with respect to the pontoons.

5. A vessel as claimed in claim 4, wherein the hydraulic rams are also adapted to restore the centre hull structure to a normal orientation with respect to the pontoons after said abnormal wind forces have abated.

6. A water vessel having a hull provided with a keel, wherein the keel is movable with respect to the hull between raised and lowered positions in which respectively different depths of keel are exposed below the hull, wherein means is provided for positively locking the keel to the hull at least in each of said raised and lowered positions.

7. A vessel as claimed in claim 6, wherein the keel is provided with at least one structural beam which extends transversely with respect to the plane of the keel, and wherein said means for locking the keel in each of its raised and lowered positions comprises complimentary male and female formations on the beam and hull respectively, said formations being positioned to co-operate when the keel is in each of said raised and lowered positions, for resisting relative movement between the hull and keel in those positions.

8. A vessel as claimed in claim 6, wherein the keel is provided with a structural beam which extends transversely with respect to the plane of the keel, and wherein the vessel further includes guide means comprising a pair of guide rods extending through openings in the beam and on respectively opposite sides of the keel, said rods extending parallel to the plane of the keel.

9. A vessel as claimed in claim 8, wherein each of said rods is a threaded rod received in a complimentarily threaded opening in the beam, and wherein the vessel is

provided with means for rotating the rods in synchronism to raise and lower the keel under power.

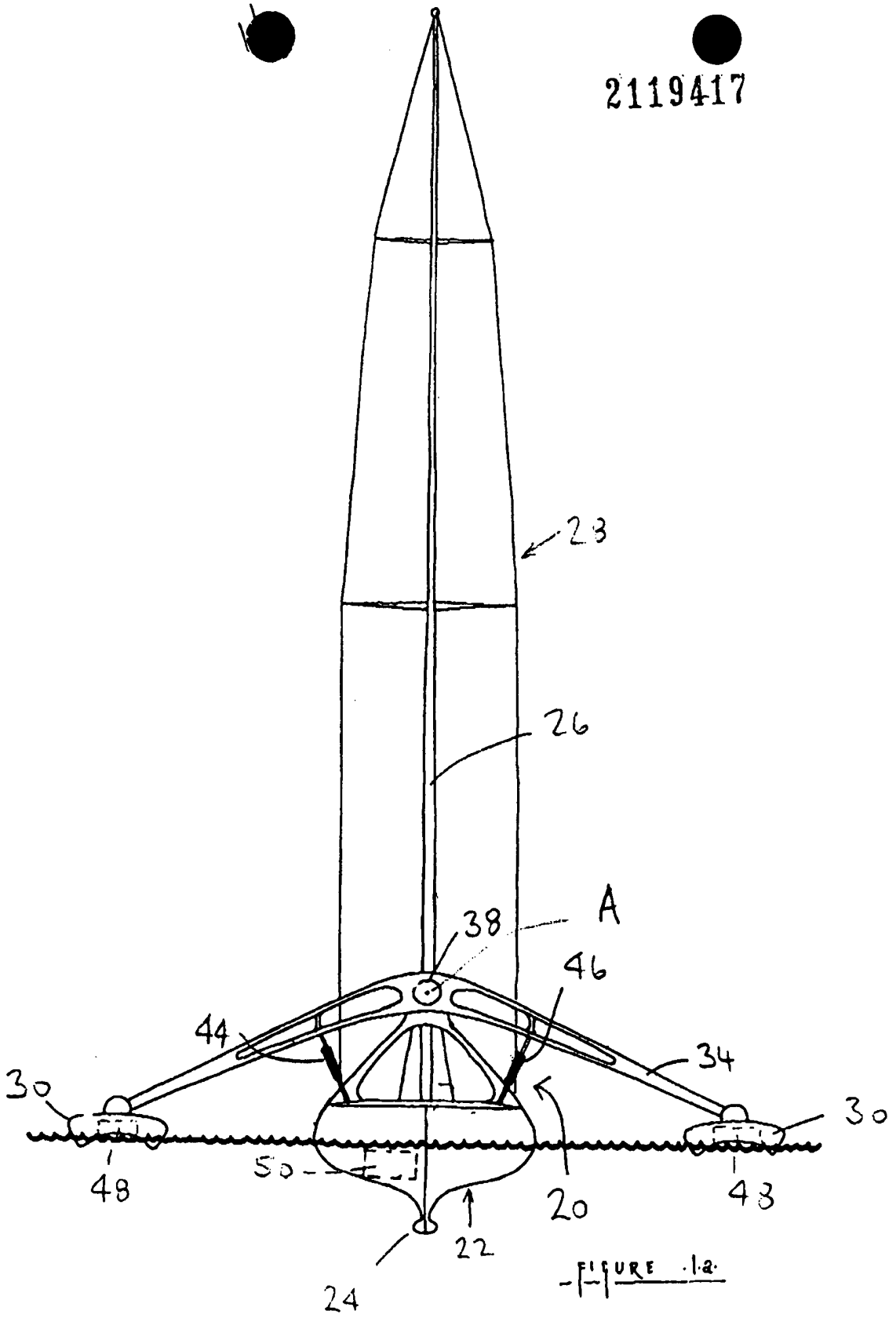

FIGURE 1a

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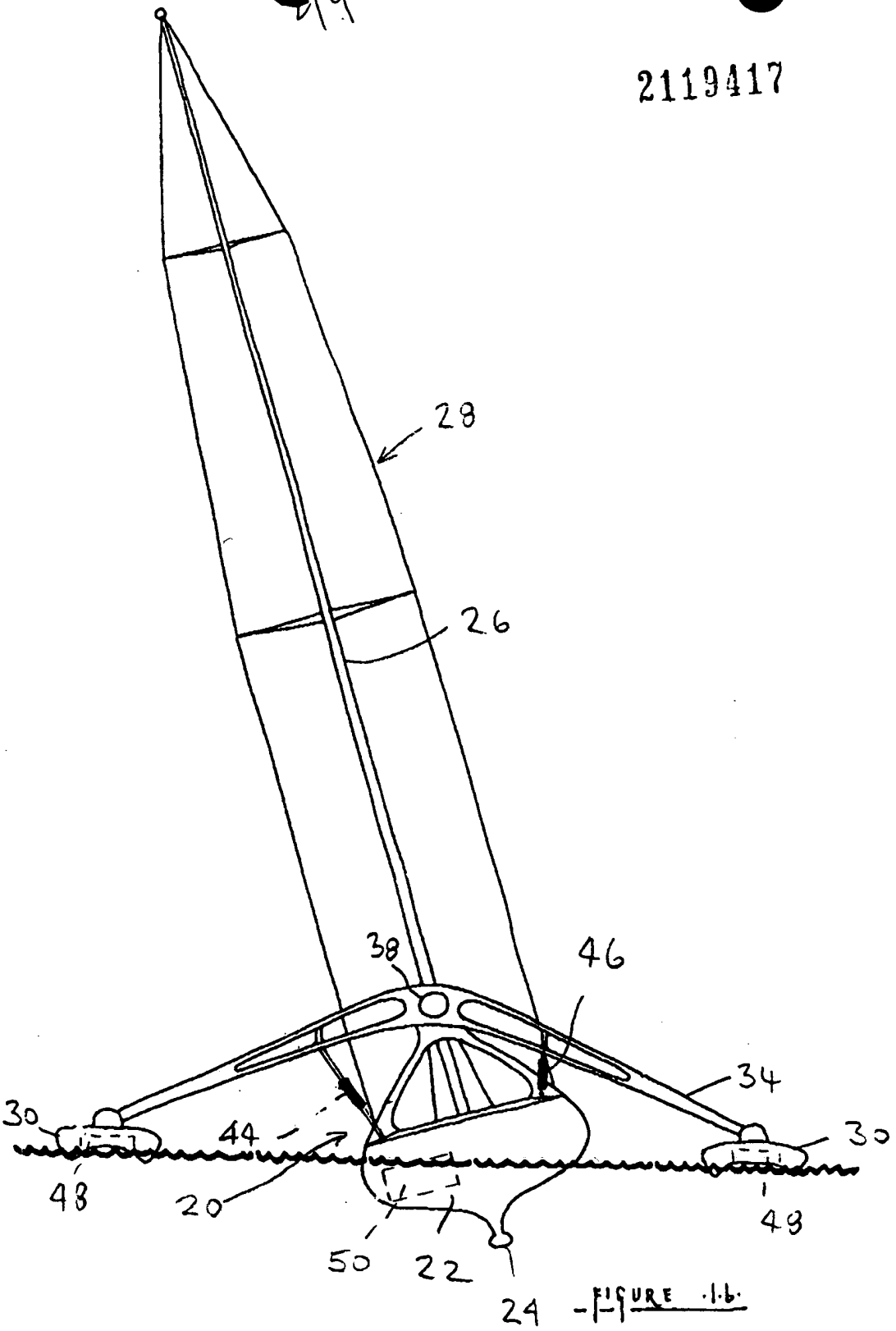

FIGURE 1.b.

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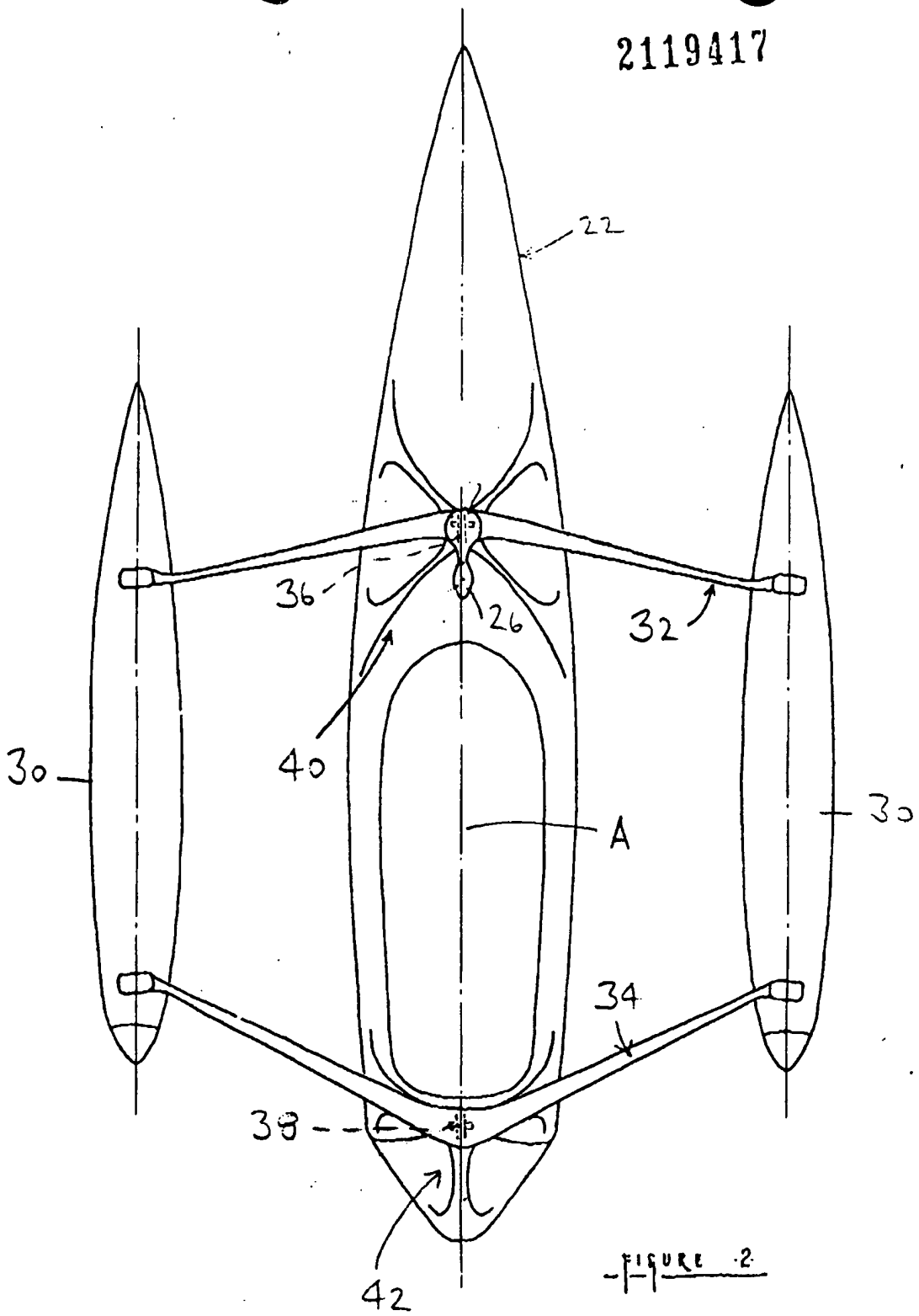

FIGURE 2

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FIGURE 3a.

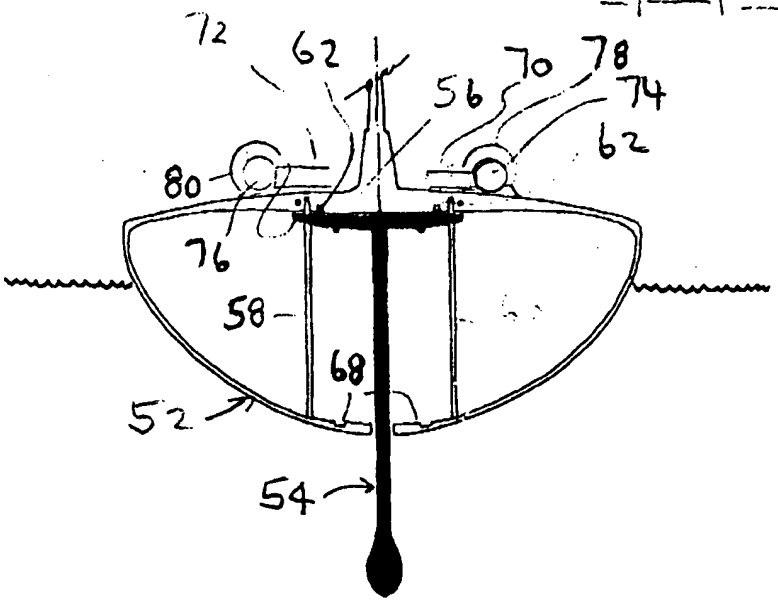

FIGURE 3-b-